LOWER PASSAIC RIVER RESTORATION PROJECT

LOWER PASSAIC RIVER STUDY AREA RI/FS

LATE SPRING/EARLY SUMMER 2010
FISH TISSUE COLLECTION
ADDENDUM TO THE
QUALITY ASSURANCE PROJECT PLAN

FISH AND DECAPOD CRUSTACEAN TISSUE COLLECTION FOR CHEMICAL ANALYSIS AND FISH COMMUNITY SURVEY

FINAL

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Revision Number: 0
Addendum Number 4

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Acronyms

CPG	Cooperating Parties Group
ERA	ecological risk assessment
HHRA	human health risk assessment
LPRRP	Lower Passaic River Restoration Project
LPRSA	Lower Passaic River Study Area
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
PA	Partner Agencies
QAPP	quality assurance project plan
RM	river mile
SOP	standard operating procedure
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
Windward	Windward Environmental LLC

Introduction

This is an addendum to the *Lower Passaic River Restoration Project Quality Assurance Project Plan: Fish and Decapod Crustacean Tissue Collection for Chemical Analysis and Fish Community Survey* (Windward 2009), hereafter referred to as the Fish/Decapod Quality Assurance Project Plan (QAPP). The Fish/Decapod QAPP, reviewed by the US Environmental Protection Agency (USEPA) and its Partner Agencies (PA)[1] and approved by USEPA on August 6, 2009, describes the tissue collection effort for the Lower Passaic River Study Area (LPRSA) which took place during late summer/early fall 2009. This addendum to the Fish/Decapod QAPP, hereafter referred to as the Fish/Decapod QAPP Addendum No. 4, describes the collection of tissue samples from target fish species to meet data needs identified in the USEPA-approved Fish/Decapod QAPP.

Field activities will occur during the late spring/early summer 2010 over a 3-week-period and will be concurrent with the late spring/early summer 2010 fish community survey field effort (described in the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b). Data proposed to be collected will include:

- Chemical concentrations in tissue samples from target fish species collected from the LPRSA, including mummichog and darter/killifish as well as smallmouth bass and largemouth bass that are ≥ 450 g
- Fish egg lipid content from mummichog and darter/killifish egg composite samples collected from the LPRSA
- Egg counts and mass estimates from mummichog egg samples collected from the LPRSA

In addition, any of the selected alternative small forage fish species caught (i.e., Atlantic silversides, bluegill, spottail shiners, redbreast sunfish, and pumpkinseed) that are ≤ 5 in. in length will be retained for potential tissue chemical analysis. The decision whether to analyze these alternative fish will be made following the completion of the sampling effort based on discussions between the USEPA and the Cooperating Parties Group (CPG).

A summary of the late summer/early fall 2009 field effort for mummichog and darter/killifish is presented in the *Lower Passaic River Restoration Project Fish and Decapod Field Report for the Late Summer/Early Fall 2009 Field Effort* (Windward 2010a), hereafter referred to as the Late Summer/Early Fall 2009 Fish/Decapod Field Report. Following several fishing attempts for mummichog and darter/killifish during the late summer/early fall 2009 tissue collection effort, USEPA directed the CPG to include another fishing effort for these species to coincide with the late spring/early summer 2010 fish community survey. The effort to collect mummichog and darter/killifish tissue, including the number of attempts and number of traps deployed in each reach, will follow the sample design provided in the approved Fish/Decapod QAPP (Windward 2009) and may including additional fishing methods (e.g., dip nets, cast nets) that were attempted during the late summer/early fall 2009 fish community survey and documented in the Late Summer/Early Fall 2009 Fish/Decapod Field Report.

[1] The Partner Agencies include the US Army Corps of Engineers (USACE), New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation (NJDOT), National Oceanic and Atmospheric Administration (NOAA), and the US Fish and Wildlife Service (USFWS).

In addition to the limited numbers of mummichog and darter/killifish caught during the late summer/early fall 2009 field effort (Windward 2010a), too few bass specimens (i.e., largemouth and smallmouth bass) were collected. Therefore, CPG will retain any largemouth or smallmouth bass caught during the late spring/early summer 2010 field effort that are ≥ 450 g for tissue chemistry analysis.

Fish/Decapod QAPP Addendum No. 4 includes updates to worksheets and attachments relevant to the late spring/early summer 2010 tissue collection effort. It does not include worksheets or attachments that are unchanged or not relevant to this effort. Applicable and/or updated worksheets and attachments included in this addendum are presented below:

- Worksheet No. 1 contains the title and approval pages for the addendum.
- Worksheet No. 3 provides the distribution list.
- Worksheet No. 10 describes the specific problem definition.
- Worksheet No. 11 provides the project quality objectives.
- Worksheet No. 18 provides a list of proposed sampling locations.
- Attachment J provides the updated procedures for fish surveys, collection, and tissue sampling as follows:
  - Dip nets and cast nets have been added as sampling methods.
  - Text has been added to address the fact that damaged or compromised fish will not be retained for tissue analysis.
  - Procedures for collecting and counting mummichog eggs have been updated.
- Attachment L provides the updated procedures for boat and backpack electrofishing, including the following clarifications:
  - Electrofishing may be conducted in water with a temperature above 18° C.[2]
  - Any potential damage to fish as a result of electrofishing will not impact the chemical analysis of the tissue.

[2] Electrofishing is typically not permitted in water with a temperature above 18° C if salmonids are present per National Marine Fisheries Service guidelines (NMFS 2000). However, because salmonids are not present in the Lower Passaic River, electrofishing was conducted in water above 18° C during the late summer/early fall 2009 field effort. This change in procedure was documented in Protocol Modification Form No. 5 in the late summer/early fall 2009 fish community report (Windward 2010a).

QAPP Worksheet No. 1. Title and Approval Page

Addendum to the *Quality Assurance Project Plan for Fish and Decapod Crustacean Tissue Collection for Chemical Analysis and Fish Community Survey*

Document Title

Windward Environmental LLC (Windward)

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QAPP Worksheet No. 3. Distribution List

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QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

Project Name:	Lower Passaic River Restoration Project (LPRRP) Ecological and Human Health Risk Assessments
Site Name:	LPRSA
Projected Date(s) of Sampling:	May – June 2010
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc. (dmi)
Date of Session:	May 21, 2010
Scoping Session Purpose:	Conference call to discuss final preparations for the late spring/early summer 2010 fish tissue collection effort

Participants: USEPA, dmi, CDM, AECOM, Windward

Name	Affiliation	Phone No.	E-mail Address
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Conference Call to Discuss the Late Spring/Early Summer 2010 Fish Tissue Collection Effort	
Purpose/ Decisions:	A conference call between USEPA and CPG to discuss the proposed fish tissue collection effort during the late spring/early summer 2010 was held May 21, 2010. Based on the discussion during the call, the parties agreed to the following items: • CPG will retain small forage fish (fish < 5 in. in length and with small home ranges similar to ecological feeding guild and foraging range of mummichog and darter/killifish. Fish species proposed by USEPA include spottail shiners, pumpkinseed, redbreast sunfish, and bluegill. USEPA and CPG will discuss the appropriateness of analyzing these alternative fish species. • CPG will conduct a reconnaissance effort during the week of May 24 and collect gravid mummichog and darter/killifish, if present, for egg count and lipid analysis and retain additional specimens of mummichog and darter/killifish as well as other small forage fish caught (as discussed, above) for potential future tissue analysis. • During the later spring/early summer 2010 fish tissue collection effort (expected to begin during the week of June 21, 2010), eggs will be collected from gravid small forage fish, if necessary, to fill remaining data needs for egg lipid analysis, although collecting small forage fish for tissue analysis will be the priority. • CPG agrees to consider retaining smallmouth bass, largemouth bass, and northern pike at least 10 in. in length. CPG will discuss with USEPA keeping crayfish, if any are found. However, it is CPG's understanding that as part of the approval of the crab analysis and compositing plan crayfish were replaced with blue crab in the freshwater section of the river. CPG does not agree to schedule additional data collection efforts for crayfish. • USEPA and CPG will work together to plan any needed additional sampling events if tissue needs for small forage fish (whole body and egg lipid) are not met by May and June events.

QAPP Worksheet No. 9. Project Scoping Session Participants Sheet

Project Name:	LPRRP Ecological and Human Health Risk Assessments
Site Name:	LPRSA
Projected Date(s) of Sampling:	May – June 2010
Site Location:	LPRSA
Project Manager:	Bill Potter/Robert Law, de maximis, inc.
Date of Session:	May 25, 2010
Scoping Session Purpose:	Conference call to discuss the late spring/early summer 2010 fish tissue collection effort

Participants: USEPA, Windward

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Conference Call to Discuss the Late Spring/Early Summer 2010 Fish Tissue Collection Effort	
Purpose/Decisions:	A follow-up call between USEPA and CPG to discuss the collection of fish tissue during the May 2010 small forage fish reconnaissance effort and the late spring/early summer 2010 fish tissue collection effort was held on May 25, 2010. The discussion took place after the first day of fishing during the May small forage fish reconnaissance effort. Based on the discussion during the call, the parties agreed to the following items: • Smallmouth bass and largemouth bass caught during the field effort will be retained for tissue analysis if an individual weighs at least 450 g. Fish weighing less than 450 g will be released. • Northern pike will not be retained. • Atlantic silversides, discussed as a potential substitute for mummichog, will not be retained if caught during the May reconnaissance effort because mummichog are being caught. However, Atlantic silversides remain a potential alternative fish for the late spring/early summer 2010 fish tissue collection effort if mummichog are not present in the system at that time.

QAPP Worksheet No. 10. Problem Definition

The problem to be addressed by the project:
Limited numbers of several target fish species (i.e., mummichog, darter/killifish, and largemouth bass) were collected during the late summer/early fall 2009 fish tissue collection effort. The tissue mass collected for mummichog and darter/killifish composite samples during the late summer/early fall 2009 tissue collection effort was insufficient for chemical analysis, and no fish egg composite samples were collected during this effort.[3] At the direction of USEPA, CPG attempted to collect additional mummichog using minnow traps and cast nets during a supplemental field effort on October 13, 2009, which was attended by CPG, USEPA, National Oceanic and Atmospheric Administration (NOAA), and New Jersey Department of Environmental Protection (NJDEP). Only a few mummichog were collected as a result of this additional effort. Subsequently, USEPA directed the CPG to conduct another sampling effort for these species (including fish eggs) concurrent with the late spring/early summer 2010 fish community survey. Therefore, whole-body tissue samples (and fish eggs only for lipid-content analysis) from mummichog and darter/killifish will be collected and retained for chemical analysis to address data needs that remained after the late summer/early fall 2009 tissue collection effort. In order to ensure that the sampling of mummichog would be conducted during their reproductive season so that eggs could be obtained for lipid analysis, CPG agreed to USEPA's request (USEPA 2010) to conduct a small forage fish reconnaissance survey targeting gravid mummichog and darter/killifish during 1 week in May prior to the 3-week fish tissue collection effort. During the reconnaissance survey, all small forage fish collected will be retained for possible tissue chemistry analysis (Windward 2010d). The decision whether to analyze any of the small forage fish collected during the May reconnaissance survey will be made following the completion of the 3-week late spring/early summer 2010 field effort based on discussions between the USEPA and the CPG. In addition to the limited numbers of mummichog and darter/killifish caught during the late summer/early fall 2009 field effort (Windward 2010a), too few bass specimens (i.e., largemouth and smallmouth bass) were collected. At the request of USEPA (USEPA 2010), and as discussed in subsequent conversations between USEPA and CPG on May 21 and 24, 2010, CPG will retain any largemouth or smallmouth bass caught during the late spring/early summer 2010 field effort that are ≥ 450 g for tissue chemistry analysis (sampling methods for the late spring/early summer 2010 fish community survey are presented in Fish/Decapod QAPP Addendum No. 3 (Windward 2010b)). Any largemouth or smallmouth bass caught during the fish community survey that are < 450 g will be released.

[3] A summary of the effort to collect mummichog and darter/killifish composite samples and fish egg composite samples is presented in the Late Summer/Early Fall 2009 Fish/Decapod Field Report (Windward 2010a).

QAPP Worksheet No. 10. Problem Definition

The environmental questions being asked:

The tissue samples (including mummichog and darter/killifish egg composite samples) collected during the late spring/early summer 2010 tissue collection effort will be used as part of the larger fish tissue dataset to address two questions:

- Are residues from chemicals of potential concern in fish tissue from the LPRSA at levels that might cause an adverse effect on the survival, growth, and/or reproduction of small-home-range fish (prey) or freshwater bass species that use the LPRSA?
- What are the potential adverse effects of river chemicals on human health (for the reasonable maximum exposure of individuals under current and future exposure scenarios for both cancer and non-cancer health effects) via the consumption of fish and on ecological receptors via the ingestion of prey fish from the LPRSA?

These questions are consistent with those defined in the Fish/Decapod QAPP (Windward 2009) and also are presented as part of the ecological risk assessment (ERA) and human health risk assessment (HHRA) approach in the *LPRSA Human Health and Ecological Risk Assessment Streamlined 2009 Problem Formulation* (Windward and AECOM 2009).

Project decision conditions:

The conditions for project decisions (i.e., those decisions that may require communication between CPG and USEPA during the field effort) include the need to relocate sampling locations within the LPRSA and the need to delay or suspend sampling because of hazardous weather conditions. The CPG will immediately suspend operations under conditions of extreme weather and/or environmental conditions that are a threat to worker health and safety.

Additional project decisions that are specifically relevant to the collection of mummichog and darter/killifish tissue are presented in the Fish/Decapod QAPP (Windward 2009) and include:

- The identification and size of target species for collection
- The target minimum tissue mass for collection
- The priority list of chemicals for analysis
- The inclusion of individual specimens and composite samples for analysis
- The minimum tissue mass for composite egg samples

The conditions for these decisions are the same as those presented in the Fish/Decapod QAPP (Windward 2009).

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

What will the data be used for?

The data collected during this effort will be used as specified in Worksheet No. 11 of the Fish/Decapod QAPP (Windward 2009). A summary of the data uses per data type is provided below.

Fish tissue collection

Tissue samples will be collected from target small forage fish species (i.e., mummichog and darter/killifish) and freshwater bass species that are ≥ 450 g (i.e., largemouth and smallmouth bass[4]) to address remaining data needs from the late summer/early fall 2009 tissue collection effort. These data will be used in conjunction with the tissue chemistry data collected during the late summer/early fall 2009 tissue collection effort to address assessment endpoints for the ERA as described in the Fish/Decapod QAPP (Windward 2009). Tissue samples from selected alternative small forage fish species (i.e., Atlantic silversides, bluegill, spottail shiners, redbreast sunfish, and pumpkinseed) that are ≤ 5 in. in length will be retained for potential chemical analysis. The decision whether to analyze these fish will be made following the completion of the sampling effort based on discussions between the USEPA and the CPG. During the sampling effort, if mummichog and/or darter/killifish are being caught, or are projected to be caught, in numbers sufficient to meet the target number of samples, USEPA and CPG will consider whether the continued retention of these alternative forage fish species is necessary.

Largemouth or smallmouth bass data collected during this sampling effort will also be used to evaluate potential human consumption scenarios in support of the HHRA. As defined in the *LPRSA Human Health and Ecological Risk Assessment Streamlined 2009 Problem Formulation* (Windward and AECOM 2009), the data use objective is to estimate potential human exposure and assess the potential adverse effects of river chemicals to human health via the consumption of fish collected throughout the LPRSA.

Fish egg collection

Fish eggs will be collected (when possible) from gravid females of target species (i.e., mummichog, darter/killifish) for lipid content analysis to develop adult-to-egg lipid ratios and to estimate egg chemical concentrations from adult chemical concentrations. Estimated egg tissue chemical concentrations or toxic equivalencies will be compared to egg tissue-residue toxicity reference values to address assessment endpoints for the ERA as described in the Fish/Decapod QAPP (Windward 2009).

In addition, per USEPA direction (as detailed on Worksheet No. 11 of the Fish/Decapod QAPP (Windward 2009)), the number

[4] Reconstituted whole-body concentrations of bass for use in the ERA will be derived by combining the analytical results for fillet and carcass samples and adjusting for the relative weight of each fraction, consistent with the *Lower Passaic River Restoration Project Draft Field Sampling Plan*. Volume 2 (Malcolm Pirnie et al. 2006).

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

and/or mass of mummichog eggs collected for the lipid-content analysis will be estimated per gravid female (when possible) in order to answer the following risk question: "What are the approximate egg numbers and/or mass of estuarine benthic omnivores (i.e., mummichog) from the LPRSA?" These data will be used to assist in the interpretation of the results in terms of fish population health and general fecundity of mummichog in the LPRSA.

What types of data are needed?

The data types are presented above, under the question: "What will the data be used for?" They include:

- The chemical analysis of mummichog and darter/killifish tissue samples (and potential chemical analysis of alternative small forage fish species [i.e., Atlantic silversides, bluegill, spottail shiners, redbreast sunfish, and pumpkinseed])
- The chemical analysis of largemouth bass and smallmouth bass ≥ 450 g
- The evaluation of egg lipid content in mummichog and darter/killifish egg composite samples
- An estimate of the number and/or mass of eggs from individual gravid female mummichog specimens that are collected for lipid-content analysis

These data types are consistent with those presented in the Fish/Decapod QAPP (Windward 2009).

How many data are needed?

The proposed sample size and number of locations that will be targeted for the late spring/early summer 2010 tissue collection effort are consistent with those proposed in the Fish/Decapod QAPP (Windward 2009). This tissue collection effort will be conducted concurrently with the late spring/early summer 2010 fish community survey and thus will target the same locations proposed in the Fish/Decapod QAPP Addendum No. 1 (Windward 2010c), which described the winter 2010 fish community survey plan, and the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b), as well as additional locations (all sampling locations are described below under the question: "Where will the data be collected?").

Fish tissue sample collection

The number of whole-body mummichog and darter/killifish tissue samples proposed for collection during the late spring/early summer 2010 tissue collection effort is consistent with the sample numbers presented in Table 11-1 of the Fish/Decapod QAPP (Windward 2009) and include:

- 39 whole-body composite tissue samples of mummichog from 13 locations in the estuarine zone
- 42 whole-body composite tissue samples of darter/killifish species from 14 locations in the freshwater zone

Sampling locations are described below, under the question: "Where will the data be collected?"

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

The number of largemouth and smallmouth bass that will be retained is dependent on the catch results of the late spring/early summer 2010 fish community survey (see the Fish/Decapod QAPP Addendum No.3 (Windward 2010b)). Only those largemouth and smallmouth bass ≥ 450 g will be retained for tissue analysis; bass < 450 g will be released).

Fish egg samples

Consistent with the Fish/Decapod QAPP (Windward 2009), and depending on the availability of fish for tissue chemistry analysis, additional gravid fish will be collected for fish egg lipid-content analysis. Ten mummichog egg tissue composite samples will be collected in the estuarine zone, and ten darter/killifish egg tissue composite samples will be collected in the freshwater zone. These samples will be submitted to the laboratory for lipid analysis to determine site-specific egg lipid content in order to model/estimate fish egg exposure concentrations. Per USEPA request, egg count and/or mass will be estimated (when possible) for each gravid female mummichog specimen collected for the egg lipid content analysis.

Where, when, and how should the data be collected/generated?

A summary of the sampling locations and field survey methods is presented below.

Where will the data be collected?

The selected sampling locations (and the rationale for each location) for the late spring/early summer 2010 tissue collection effort targeting small forage fish are presented in Worksheet No. 18 of this addendum and illustrated in Figure 1. Because this effort will be conducted concurrent with the late spring/early summer 2010 fish community survey, some sampling locations (including those where methods such as electrofishing will be used to target largemouth and smallmouth bass) overlap with the fish community survey locations where minnow traps will be deployed (all fish community survey locations are described in Worksheet No. 18 of the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b)).

Twenty-nine out of one-hundred and fifty-two locations from the late summer/early fall 2009 field effort have been selected for the collection of mummichog and darter/killifish and include:

- Twenty-seven locations where minnow traps were deployed during the late summer/early fall 2009 field effort, sixteen of which are included in the late spring/early summer 2010 fish community survey (described in the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b))
- Two locations in Reach 8 (LPR8Y and LPR8Z) that were identified for backpack electrofishing based on catch results during the late summer/early fall 2010 fish community survey

Consistent with the sampling procedures described in the Fish/Decapod QAPP (specifically under “Where, when, and how should the data be collected/generated?” on Worksheet No. 11 (Windward 2009)), sampling locations may be moved based on catch success for that location; additional mudflats within each reach may also be targeted as additional sampling locations. If, after two attempts, it is determined that the sampling locations are unproductive (e.g., low catch success) and locations that are potentially

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

more productive are identified, traps may be relocated to new (alternative) locations for the remaining attempts within the same reach. Five locations in Reaches 1 and 2 identified by USEPA/PA on October 13, 2009, as providing suitable habitat for mummichog (Windward 2010a) are identified in Worksheet 18 and on Figure 1 and may be targeted as alternative locations. The movement of traps to alternative sampling locations will be discussed with and agreed upon by USEPA and CPG.

Three minnow traps will be deployed at each minnow trap location, and three electrofishing attempts will be made at LPR8Y and LPR8Z. The number of traps per location, as well as the number of backpack electrofishing attempts per location, are consistent with the level of effort specified for mummichog and darter/killifish sampling in the Fish/Decapod QAPP (Windward 2009).

The mummichog and darter/killifish sampling during the late summer/early fall 2009 field effort involved various modifications (i.e., relocation of minnow traps, additional fishing methods, various bait) in an attempt to collect these species (Windward 2010a). Similar modifications may be needed during the late spring/early summer 2010 tissue collection effort; all modifications will be communicated with USEPA in advance.

When will the data be collected?

The late spring/early summer 2010 tissue collection effort will be conducted concurrent with the late spring/early summer 2010 fish community survey during a 3-week period. The 3-week sampling effort will be preceded by a 1-week reconnaissance survey in May. During the 3-week sampling effort (expected to start the week of June 21, 2010), minnow traps will be deployed for up to five attempts per location in an effort to collect sufficient mummichog and darter/killifish biomass for the tissue composite samples. The number of attempts per location is consistent with the level of effort described for the mummichog and darter/killifish tissue sample collection in the Fish/Decapod QAPP (Windward 2009). Traps will be deployed overnight, and sampling attempts in two to three reaches will be conducted each day. The methods for the reconnaissance survey are presented in the memorandum Reconnaissance for Small Forage Fish (Windward 2010d).

An evaluation of fish community literature suggests that mummichog are gravid and spawn over a period of approximately 5 days on a semi-lunar cycle (during full or new moons) when tides are at their highest. Therefore, the lunar cycle will be considered, if possible, when planning for the late spring/early summer 2010 field effort.

If traps are deployed at alternative locations, the level of effort will be defined either by a maximum of five attempts or the completion of the working week during which a reach is sampled, whichever comes first.

How will the data be collected?

Fishing methods for the late spring/early summer 2010 tissue collection effort will be primarily the use of minnow traps, which are specialized for the collection of mummichog and darter/killifish. Minnow traps will be deployed on or near shallower mudflat areas. In addition, backpack electrofishing will be used at two locations in Reach 8 (LPR8Y and LPR8Z), where shallow waters prevent the deployment of minnow traps. Other methods (including electrofishing and the use of eel traps, trotlines, and gillnets) that will be used in the late spring/early summer 2010 fish community survey are described in the Fish/Decapod QAPP Addendum No. 3

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

(Windward 2010b). The late spring/early summer 2010 fish community survey will be conducted concurrently with the tissue collection effort, and any mummichog, darter/killifish, and largemouth and smallmouth bass ≥ 450 g collected using these methods will be retained for tissue chemistry analysis. Selected alternative small forage fish species (i.e., Atlantic silversides, bluegill, spottail shiners, redbreast sunfish, and pumpkinseed) caught using minnow traps or any of the sampling methods employed during the fish community survey will also be retained for potential chemical analysis. Dip nets and/or cast nets may also be used in the shallower mudflat areas, where and when appropriate (at the discretion of field personnel), to augment all other fishing methods. Standard operating procedures (SOPs) for all fish methods are described in the revised Attachment J: SOP—Fish Surveys, Collection, and Tissue Sampling, and revised Attachment L: SOP—Fish Collection by Backpack and Boat Electrofishing (attached to this document). All mummichog or darter/killifish specimens collected by any method (i.e., traps, nets, trotline, gillnets, or electrofishing) will be included in whole-body tissue (or egg) composite samples.

Mummichog, darter/killifish, and largemouth and smallmouth bass ≥ 450 g will be retained for tissue chemistry analysis and will be processed for shipment to the analytical laboratory as described in the Fish/Decapod QAPP (Windward 2009). Tissue samples from alternative small forage fish species (i.e., Atlantic silversides, bluegill, spottail shiners, redbreast sunfish, and pumpkinseed) that are ≤ 5 in. in length will be retained for potential chemical analysis. The decision whether to analyze these fish will be made following the completion of the sampling effort based on discussions between the USEPA and the CPG.

Whole-body composite tissue samples of mummichog and darter/killifish will be prioritized over egg composite samples. If specimens are determined to be gravid and are not needed to meet the mass requirements for whole-body composite tissue samples, the eggs will be harvested, counted and/or weighed (if mummichog eggs) to estimate egg numbers and/or mass per gravid individual, and composited (up to 10 composite samples per species) for lipid-content analysis. The specimens included in the egg composite samples will also be evaluated, as necessary, for gross internal and external pathology as described in the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b). The methods for harvesting and weighing and/or counting mummichog eggs are presented in revised Attachment J: SOP—Fish Surveys, Collection, and Tissue Sampling, which is attached to this addendum. All changes to the proposed plan as a result of field conditions will be communicated between USEPA and CPG technical coordinators or project managers.

Who will collect and generate the data?

Windward will provide the field sampling coordination and most of the field personnel required to conduct the late spring/early summer 2010 tissue collection effort. Windward will be supported by its contractor Aqua Surveys, Inc., as well as de maximis, inc., and AECOM field personnel, as required.

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How will the data be reported?
Updates will be communicated (e.g., via telephone conversation, e-mail) to CPG project managers and project coordinators. An electronic database that includes the coordinates for the location where each trap is deployed, as well as for each fish collected, will be maintained. The database will include the time of trap deployment and retrieval; time of fish collection; depth of collection or trap deployment; and species, length, weight, and (if determinable) gender of all individual fish collected for analysis. A data summary report summarizing the tissue collection and analysis results will be provided 90 days after receipt of validated chemical data. In addition, this report will include a map that presents the tissue collection locations. The data summary report will summarize any modifications to the proposed sampling plan outlined in this QAPP addendum.
How will the data be archived?
Data records, forms, and notes will be scanned and stored electronically in a project file. Hard copies will be archived at Windward's main office in Seattle, Washington. Similarly, the data reports will be issued and then archived electronically and as hard copies.

QAPP Worksheet No. 18. Proposed Mummichog and Darter/Killifish Sampling Locations for the Late Spring/Early Summer 2010 Tissue Collection Effort

Sampling Location	Easting (X)[a]	Northing (Y)[a]	Bank	RM	Fishing Method[b]	Previous Field Event	Species Previously Collected[c]	Description and Rationale for Sampling Location[d]
Reach 1								
LPR1A[e]	598862	685983	East	0.4	Minnow trap	Late summer/ early fall 2009 and winter 2010	Atlantic silversides, goby, white perch, and Northern pipefish	Mudflat at Kearney Point; aquatic vegetation along shoreline; depositional area characterized mostly by silt
LPR1B	598145	686254	East	0.4	Minnow trap	Late summer/ early fall 2009	Atlantic silversides, goby, white perch, and Northern pipefish	Aquatic vegetation along shoreline; substantial mudflat at Kearney Point
LPR1D[e]	597403	690438	West	1.25	Minnow trap	Late summer/ early fall 2009 and winter 2010	Atlantic silversides, goby, white perch, mummichog, and American eel	Shallow mudflat with some riprap; depositional area characterized mostly by silt; near location sampled by Tierra Solutions in 1999/2000
Reach 2								
LPR2B[e]	596928	695100	West	2.3	Minnow trap	Late summer/ early fall 2009 and winter 2010	Atlantic silversides, white perch, and mummichog	Shallow mudflat between I-295 and Point-No-Point bridges; depositional area characterized mostly by silt and silt and sand
LPR2E	590126	692885	East	3.9	Minnow trap	Late summer/ early fall 2009	American eel and white perch	Vegetated shoreline, shallow mudflat area
LPR2G[e]	592218	695220	East	3.3	Minnow trap	Late summer/ early fall 2009 and winter 2010[f]	American eel	Riprap, vegetation, large woody debris; near submerged pilings, deeper water
Reach 3								
LPR3A[e]	588537	692671	East	4.2	Minnow trap	Late summer/ early fall 2009 and winter 2010	Atlantic silversides and white perch	Shallow mudflat area with aquatic vegetation nearby; depositional area characterized mostly by silt and sand; near locations sampled by Tierra Solutions in 1999/2000
LPR3C	585170	694440	West	5.0	Minnow trap	Late summer/ early fall 2009	White perch, American eel, and white catfish	Mudflat area; shallow, surrounded by concrete wall

QAPP Worksheet No. 18. Proposed Mummichog and Darter/Killifish Sampling Locations for the Late Spring/Early Summer 2010 Tissue Collection Effort

Sampling Location	Easting (X)[a]	Northing (Y)[a]	Bank	RM	Fishing Method[b]	Previous Field Event	Species Previously Collected[c]	Description and Rationale for Sampling Location[d]
LPR3K[e]	584668	698342	West	5.75	Minnow trap	Late summer/ early fall 2009 and winter 2010	White perch, American eel, and brown bullhead	Riprap and wood pilings, deeper water
Reach 4								
LPR4C	586679	704045	West	6.9	Minnow trap	Late summer/ early fall 2009	American eel	Steel bulkhead, no vegetation, shallow mudflat
LPR4D[e]	587489	705720	East	7.3	Minnow trap	Late summer/ early fall 2009	American eel	Shallow mudflat, no vegetation
LPR4M[e]	585151	701600	West	6.5	Minnow trap	Late summer/ early fall 2009 and winter 2010	American eel and white perch	Wooden bulkhead with coniferous plants and shrubs on top and several pipes that terminate at the river; depositional area characterized mostly by silt
Reach 5								
LPR5J[e]	592097	717356	East	9.75	Minnow trap	Late summer/ early fall 2009 and winter 2010	American eel, carp, largemouth bass, pumpkinseed, smallmouth bass, white sucker, banded killifish, bluegill, and spottail shiner	Mud, gravel, riprap, aquatic grass, and shrubs, trees on bank
LPR5M[e]	590284	712972	West	8.75	Minnow trap	Late summer/ early fall 2009 and winter 2010	American eel, white sucker, and tessellated darter	Above the confluence with the Second River; concrete wall with some overhanging vegetation; depositional area characterized mostly by silt

QAPP Worksheet No. 18. Proposed Mummichog and Darter/Killifish Sampling Locations for the Late Spring/Early Summer 2010 Tissue Collection Effort

Sampling Location	Easting (X)[a]	Northing (Y)[a]	Bank	RM	Fishing Method[b]	Previous Field Event	Species Previously Collected[c]	Description and Rationale for Sampling Location[d]
LPR5S	589702	711831	West	8.5	Minnow trap	Late summer/ early fall 2009	Banded killifish, common carp, pumpkinseed, redbreast sunfish, spottail shiner, white catfish, white perch, and largemouth bass	Near the N Arlington bridge; overhanging vegetation, riprap
Reach 6								
LPR6A[e]	592574	722245	East	10.7	Minnow trap	Late summer/ early fall 2009 and winter 2010	American eel, brown bullhead, pumpkinseed, smallmouth bass, white sucker, bluegill, and rock bass	Shallow mudflat with gravel and overhanging trees and vegetation; depositional area characterized mostly by gravel and sand and silt and sand
LPR6C	594226	723825	West	11.2	Minnow trap	Late summer/ early fall 2009	Tessellated darter and spottail shiner	Just below the confluence with Third River; concrete wall, overhanging vegetation
LPR6D[e]	595137	724114	West	11.4	Minnow trap	Late summer/ early fall 2009 and winter 2010	White perch, pumpkinseed, and tessellated darter	Above the confluence with Third River; shallow mudflat with overhanging vegetation and trees; substrate of mostly gravel and sand and silt and sand
LPR6I	592606	722494	East	10.8	Minnow trap	Late summer/ early fall 2009	Tessellated darter	Shallow mudflat with gravel; overhanging trees and vegetation
LPR6J	593319	723608	West	11.0	Minnow trap	Late summer/ early fall 2009	Tessellated darter	Overhanging trees and vegetation; concrete wall; riprap
Reach 7								
LPR7C	596686	733029	West	13.25	Minnow trap	Late summer/ early fall 2009	Bluegill and white catfish	Concrete wall, overhanging trees

QAPP Worksheet No. 18. Proposed Mummichog and Darter/Killifish Sampling Locations for the Late Spring/Early Summer 2010 Tissue Collection Effort

Sampling Location	Easting (X)[a]	Northing (Y)[a]	Bank	RM	Fishing Method[b]	Previous Field Event	Species Previously Collected[c]	Description and Rationale for Sampling Location[d]
LPR7D[e]	597447	734889	East	13.7	Minnow trap	Late summer/ early fall 2009 and winter 2010	American eel and redbreast sunfish	Shallow mudflat with riprap and overhanging trees; depositional area characterized mostly by silt and sand
LPR7K	596730	728805	West	12.4	Minnow trap	Late summer/ early fall 2009	Tessellated darter	Overhanging trees; riprap; steeply sloped wooded bank; very little shoreline
LPR7Q[e]	596587	729111	West	12.5	Minnow trap	Late summer/ early fall 2009 and winter 2010	American eel, white perch, white catfish, channel catfish, bluegill, and tessellated darter	Shaded with trees; rocks, large woody debris, deeper water
Reach 8								
LPR8D	599182	741745	West	16.1	Minnow trap	Late summer/ early fall 2009	American eel, largemouth bass, and redbreast sunfish	Shallow rock and gravel substrate, riprap, overhanging trees and vegetation along shoreline; depositional area characterized mostly by gravel and sand
LPR8K[e]	597509	737734	East	14.2	Minnow trap	Late summer/ early fall 2009 and winter 2010	Largemouth bass, bluegill, channel catfish, and redbreast sunfish	Across from the Dundee Canal; concrete wall, shallow mudflat with overhanging trees, purple loosestrife and vegetation along shoreline
LPR8U[e]	600528	737366	West	15.1	Minnow trap	Late summer/ early fall 2009 and winter 2010[f]	American eel, bluegill, common carp, pumpkinseed, redbreast sunfish, smallmouth bass, white perch, and white sucker	Overhanging trees along shoreline
LPR8Y[g]	596961	746132	East	17.1	Backpack electrofishing	Late summer/ early fall 2009	Tessellated darter	Wooded shoreline; soft substrate on shore transitioning to rocky substrate in intertidal area

QAPP Worksheet No. 18. Proposed Mummichog and Darter/Killifish Sampling Locations for the Late Spring/Early Summer 2010 Tissue Collection Effort

Sampling Location	Easting (X)[a]	Northing (Y)[a]	Bank	RM	Fishing Method[b]	Previous Field Event	Species Previously Collected[c]	Description and Rationale for Sampling Location[d]
LPR8Z[g]	595612	746920	East	17.4	Backpack electrofishing	Late summer/ early fall 2009	Tessellated darter	East bank of main channel just below Dundee Dam; primarily gravel and cobble with overhanging trees and vegetation along the bank
Alternative locations identified by USEPA/PA								
LPR1CC[h]	598118	686662	East	0.5	Minnow trap	Late summer/ early fall 2009	Atlantic silversides	Mudflat at Kearney Point; aquatic vegetation along shoreline and riprap; USEPA, NJDEP, NOAA, and CPG selected the location based on suitable habitat for mummichog
LPR1DD[h]	597903	692987	West	1.7	Minnow trap	Late summer/ early fall 2009	Atlantic silversides, white perch, and mummichog	Mudflat where the Morris Canal enters the Passaic River; aquatic vegetation along shoreline; mudflat at Kearney Point; aquatic vegetation along shoreline and riprap; USEPA, NJDEP, NOAA, and CPG selected the location based on suitable habitat for mummichog
LPR2AA[h]	596290	695252	West	2.5	Minnow trap	Late summer/ early fall 2009	None	Mudflat adjacent to the New Jersey Turnpike bridge; aquatic vegetation along shoreline; USEPA, NJDEP, NOAA, and CPG selected the location based on suitable habitat for mummichog
LPR2BB[h]	592584	694928	West	3.3	Minnow trap	Late summer/ early fall 2009	Atlantic silversides	Mudflat with a metal bulkhead located upstream from Diamond Alkali; USEPA, NJDEP, NOAA, and CPG selected the location based on suitable habitat for mummichog

QAPP Worksheet No. 18. Proposed Mummichog and Darter/Killifish Sampling Locations for the Late Spring/Early Summer 2010 Tissue Collection Effort

Sampling Location	Easting (X)[a]	Northing (Y)[a]	Bank	RM	Fishing Method[b]	Previous Field Event	Species Previously Collected[c]	Description and Rationale for Sampling Location[d]
LPR2CC[h]	590845	694102	East	3.5	Minnow trap	Late summer/ early fall 2009	Atlantic silversides and white perch	Mudflat area with vegetated shoreline; USEPA, NJDEP, NOAA, and CPG selected the location based on suitable habitat for mummichog

Note : Sampling locations that will target largemouth and smallmouth bass (primarily based on electrofishing) are presented in the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b)

[a] New Jersey State Plane (US survey ft).

[b] Minnow traps will be used to target mummichog and darter/killifish species for tissue sample collection. Consistent with the level of effort proposed for tissue collection in the Fish/Decapod QAPP (Windward 2009), three minnow traps will be deployed for up to five attempts per sampling location. Cast nets and/or dip nets may be used at some locations, where and when appropriate, at the discretion of field personnel.

[c] The fish species previously collected at the selected sampling location during the late summer/early fall 2009 and winter 2010 fish community surveys.

[d] The sampling location description is based on field observations during the late summer/early fall 2009 fish community survey (Windward 2010a). Substrate type is based on Malcolm Pirnie (2006).

[e] Proposed sampling locations are also locations that are proposed for the late spring/early summer 2010 fish community survey, as presented in the Fish/Decapod QAPP Addendum No. 3 (Windward 2010b). An eel trap and trotline will also be deployed at each of these locations, in addition to the minnow traps, for the late spring/early summer 2010 fish community survey.

[f] LPR2G was added to the winter 2010 fish community survey to replace LPR2E at the request of USEPA. LPR8U was added to the winter 2010 fish community survey to replace LPR8D, where fishing attempts were unsuccessful as a result of ice build-up.

[g] Electrofishing locations included based on catch results from the late fall/early summer 2009 field effort.

[h] These locations were selected on October 13, 2009, by USEPA, NJDEP, NOAA and CPG based on the fact that they were believed to provide suitable habitat for mummichog (Windward 2010a).

CPG – Cooperating Parties Group
NJDEP – New Jersey Department of Environmental Protection
NOAA – National Oceanic and Atmospheric Administration
PA – Partner Agencies
QAPP – quality assurance project plan
RM – river mile
USEPA – US Environmental Protection Agency

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Attachment J: SOP—Fish Surveys, Collection, and Tissue Sampling (Revision 1 dated June 21, 2010)

I. Introduction

This procedure, based on Standard Operating Procedure (SOP) 29 of FSP2 (Malcolm Pirnie et al. 2006), defines the procedures to be followed when conducting fish surveys and collecting fish tissue samples, where appropriate, from the Lower Passaic River Study Area (LPRSA). The fish surveys and collections will be performed, as practicable, using baited eel and minnow traps and trotlines, gillnets, and electrofishing. Although the details of sample collection will be influenced by site-specific conditions, certain aspects of sample collection can be standardized for fish sampling and collection. These procedures give descriptions of equipment, field procedures, and the documentation necessary to conduct fish population surveys and tissue sampling. Other SOPs may be used with this SOP and are addressed in the project-specific quality assurance project plan (QAPP) (Windward 2009). All data, including information on individual fish collected for analysis, as well as fishing coordinates, depths, and times will be included in an electronic database, which will be provided to USEPA.

II. Preparations for Sampling

The QAPP identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the QAPP prior to conducting field activities and ensuring that all field equipment, including sample containers and preservatives, are available and in acceptable condition.

III. Equipment and Supplies

Equipment to be used during fish surveys and the collection of fish tissue samples may include, but is not limited to the following:

- Sampling vessel
- Eel traps and bait
- Minnow traps and bait
- Trotlines, hooks, and bait
- Gillnet
- Dip net
- Cast net
- Weights and buoys (or floats)
- Ceramic knives
- Fish measuring board
- Electronic scale
- Specimen Data Form
- Field guides and taxonomic keys
- Plastic buckets and/or steel washtubs

- Sample containers
- Bubble wrap
- Ice (wet and dry)
- Insulated coolers
- Sample identification labels/tags
- Waterproof marking pens
- Ziplock bags
- Personal protective equipment (PPE) as required (e.g., disposable gloves, safety glasses)
- Tissue processing equipment
- Dissecting scope
- Camera

IV. Equipment Decontamination Procedures

Decontamination of fish tissue sampling equipment will be performed between samples collected from each location/event in accordance with procedures outlined in the Decontamination of Biological Sampling Equipment SOP (Attachment I). Personnel decontamination procedures are described separately in the health and safety plan (Attachment R).

V. Location of Sampling Stations

The position and depth of the sampling station will be established. The positioning procedures are described in Attachments G and H: Locating Sample Points Using a Hand-Held Global Positioning System (GPS) and Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS), respectively. The depth of the sampling station will be determined using either a fathometer or weighted demarcated line.

VI. Fish Surveys

The following protocol shall be implemented, as practicable, for conducting fish surveys and collecting fish tissue samples from the LPRSA at the appropriate sampling stations as described the QAPP.

A. Baited eel and minnow traps

Bait used in traps will not be analyzed for contaminant concentrations. To prevent ingested bait from impacting the anticipated tissue-residue analyses, traps will use bait contained in bait bags or perforated containers to prevent the consumption of bait. Baited traps will be deployed at three locations at each of the sampling stations during the late spring/early summer 2010 sampling. Baited traps may be deployed in conjunction with the gillnet sets. The primary goal of using these traps is to catch adult American eel, mummichogs, and darters for the tissue-residue analysis; but as a secondary goal, the traps are also likely to catch other small forage fish. Not all fish collected in these traps will be kept for tissue analysis; however, all fish collected will be counted and identified for the fish community survey.

For non-target fish that will not be retained for chemical analysis, a subsample of 10 to 15 fish may be used to generate weight and length (total) data for each species size class as part of the fish community data collection. Length, weight, and, if practicable, gender will be recorded for all individual fish retained for tissue analysis. When gender cannot be identified, gender will be recorded as "indeterminate." Each trap is made of reinforced aluminum mesh (1/4 in.) and can be buoyed with a small flotation device. Baited minnow traps for collecting mummichogs and darters will be preferentially set during the day on incoming tides to the extent possible based on the schedule of sampling activities. If sampling activities do not allow for the deployment of baited minnow traps during the day, traps will be deployed in the late afternoon to early evening hours and retrieved the following morning in the same manner as the eel traps and gillnets.

1. Place the bait into the mesh bag or on the hook attached to the center bow of the trap. Attach a float or buoy to the end of the minnow trap line.
2. Lower the trap into the water from the side of the boat, making sure that the trap is securely anchored and oriented on the river bottom. A buoy should be clearly visible on the water surface so that the minnow trap can be easily retrieved.
3. Note the time and location of deployment and retrieval and any pertinent sampling location and condition descriptions in the field logbook.
4. Retrieve traps.
5. Empty each trap into an individual clean holding container (e.g., insulated cooler) by slowly pulling the two ends of the trap apart.
6. All trapped fish will be identified, counted, weighed, measured (total length), examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages and recorded on the Specimen Data Form, which is included as Attachment C in the Fish/Decapod QAPP (Windward 2009).

B. Trotlines

Trotlines may be used to collect a variety of fish species and sizes. Each trotline will consist of a main line with baited size 4 to 6 worm hooks. Trotlines will be deployed from a boat and generally set perpendicular to the shore. To comply with federal boating regulations for navigable waterways, buoys will not be set in navigation channels. If practicable, a minimum of one trotline will be set per sampling zone. An anchor and float line will be attached to each end of the main line, and the trotline will be set overnight. Field observations will be made on the presence of bait material in the gullet of the collected fish to be retained for analysis, when possible.

1. After baiting the hooks, place the trotlines into the water from the side of the boat, making sure that the line is taut from beginning to end. An attached buoy should be clearly visible on the water surface so that the trotlines can be easily retrieved.
2. Set trotlines perpendicular to the shore.
3. Note the time and location of deployment and retrieval and any pertinent sampling location and condition descriptions in field logbook.
4. Retrieve trotlines.
5. Unhook any fish caught on the trotlines into a clean holding container.
6. Fish removed from the trotlines will be identified, counted, weighed, measured (total length), examined for gross pathological conditions, including any

abnormalities, disease conditions, or missing appendages, and recorded on the Specimen Data Form, which was included as Attachment C in the Fish/Decapod QAPP (Windward 2009).

7. Hooks will be left in during field collection but noted for the laboratory where samples will be prepared.

C. Gillnets

Multiple gillnets approximately 150 ft long and made up of six 6 x 24-ft panels with mesh sizes of 1.0 in., 1.5 in., 2.5 in., 3.0 in., 3.5 in., and 4.0 in. will be used. Each net consists of six different mesh types in order to capture various sizes of fish. Each net is equipped with lead weights and floats designed to hold the net vertically in the water column (i.e., after deployment, the bottom of the net will be suspended at least 1 ft above the bottom to avoid contact with bottom debris). The nets will be anchored with appropriate weights, and buoy lines will be rigged within 1 to 2 ft of taut with respect to the next predicted high tide following deployment. To comply with federal boating regulations for navigable waterways, buoys will not be set in navigation channels of the river. This requirement may influence the actual location of the gillnet deployments. These deployment techniques will ensure reasonable positioning of the net in the water column throughout the tidal cycle. If necessary, alternate sized gillnets may also be used under this sampling plan.

Gillnets will be deployed perpendicular to shore during the late afternoon or early evening hours and retrieved the following morning, as practicable. Generally, fish activity increases during the night, and the catch retrieved the following day will be more representative of species movement within the area. Fish caught in the gillnets may be used in the fish community survey and tissue sample collection. The following protocols will be followed, as practical, for collecting fish with gillnets.

1. Position the vessel at the site at which the gillnets are to be set.
2. Attach floats and anchor weights to surface float lines and bottom lead lines of gillnets.
3. Examine the bow of the vessel. Identify and cover with duct tape any cleats, exposed screws, and irregularities in deck rail where the net might become entangled during deployment.
4. Deploy gillnets perpendicular to shore/current from bow of vessel while vessel is in reverse. Note the time and location of deployment in field logbook.
5. Retrieve gillnets after the desired interval. Approach the net from the downwind end and slowly pull the net onto the boat.
6. Stack the gillnet into a cooler or wash tub in coils or figure eights, carefully removing fish as the net is pulled out of the water.
7. Place fish removed from the gillnets into a clean, labeled holding container (e.g., insulated cooler).
8. Fish removed from the gillnets will be identified, counted, weighed, measured (total length), examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages, and recorded on the Specimen Data Form, which was included as Attachment C in the Fish/Decapod QAPP (Windward 2009).

D. Dip nets

Long-handled dip nets come in various mesh sizes. The selected dip net should have a mesh size that is appropriate for the target species.

Fish caught in the dip net may be used in the fish community survey and for tissue sample collection. The following protocols will be followed, as practical, for collecting fish with dip nets.

1. Position the vessel parallel to the shore at the site where the dip nets are to be used.
2. Hold the dip net below the water's surface (against the side of the vessel for stability, if necessary) as the vessel slowly moves forward, remaining parallel to the shore. Note the time and location in the field logbook.
3. Pull up the dip net after the desired interval (e.g., distance or time) has passed.
4. Carefully remove any fish caught in the dip net, and place fish into a clean, labeled holding container (e.g., insulated cooler).
5. Fish removed from the dip net will be identified; counted; weighed; measured (total length); examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages; and recorded on the Specimen Data Form, which was included as Attachment C in the Fish/Decapod QAPP (Windward 2009).

E. Cast nets

Cast nets come in various mesh sizes. The selected cast net should have a mesh size that is appropriate for the target species.

Fish caught in the cast net may be used in the fish community survey and for tissue sample collection. The following protocols will be followed, as practical, for collecting fish with cast nets.

1. Position the vessel at the site where the cast nets are to be used.
2. Make sure the net is clean and free of tangles and debris.
3. Cast the net in the direction of the targeted location by releasing the net from both hands simultaneously. Note the time and location in the field logbook.
4. Once the net sinks to the bottom, slowly pull the drawstring in to close the net and trap the fish.
5. Carefully retrieve the net, and remove any fish caught in the cast net and place them into a clean, labeled holding container (e.g., insulated cooler).
6. Fish removed from the cast net will be identified; counted; weighed; measured (total length); examined for gross pathological conditions, including any abnormalities, disease conditions, or missing appendages; and recorded on the Specimen Data Form, which was included as Attachment C in the Fish/Decapod QAPP (Windward 2009).

VII. Fish Handling and Preservation

Fish collected only for identification or population surveys should be identified in the field and released. Fish that are damaged or compromised will not be retained for tissue analysis but may be included in the fish community survey, if feasible. Any observed fish mortalities will be recorded. Fish collected for tissue analysis will be assessed for external abnormalities, weighed, and measured before being wrapped in aluminum foil and double bagged in clean polyethylene ziplock bags.

Sample bags will be labeled with the sample ID (described in the QAPP), sample date and time, and crew initials. They will then be placed on wet ice on the boat, transferred to the field laboratory for further processing and preparation if necessary before storage in a standard freezer at the staging area until shipment to the analytical laboratory. The field laboratory will be staffed by field personnel during the sampling effort.

A. Collection of Fish Eggs

Efforts will be made to limit egg collection to mature ripe eggs by focusing on large females with obvious gonad enlargement. One of two methods of dry spawning (stripping) will be used for egg removal. The following procedures will be followed when stripping eggs from fish.

General Process:

1. Wear appropriate PPE required by the health and safety plan (HSP) (Attachment R). Outer gloves should be changed between each sample.
2. Place appropriately labeled pre-cleaned egg sample container on a clean, stable working surface.
3. Remove container lid and place closure side up on clean, stable work surface.
4. Place appropriately labeled whole fish sample container on clean stable work surface.
5. If possible shield working area from direct sunlight, wind, and dust.
6. Obtain individual fish, identify to species level, measure and record length and weight.
7. Rinse fish clean of sediment and organic material with distilled de-ionized water. Containerize rinsate and follow disposal procedures specified in Attachment K: Management and Disposal of Investigation-Derived Waste.

Large Fish:

1. Large females are always handled by the head and tail, rather than by the tail only, to better control the live animal.
2. Position the vent over the open egg sample container and using a closed finger rocking motion from the tips of the fingers to the back of the hand stripping the eggs from the fish. This technique is thought to be less harmful to the fish, reduces scale loss and mucus production. Personnel with small hands may have difficulty using this technique.
3. Dispatch the fish with a clean knife or scalpel by severing the spinal cord just posterior to the brain.
4. Place the egg tissue in sample container and transfer to wet ice.

5. Repeat the procedure with additional gravid female fish until sufficient egg mass/volume is obtained to meet project requirements.
6. Record the time and date on labels, close containers, and freeze samples for transport to laboratory for further processing.

Small Fish:

1. Small fish are held firmly with one hand with the head and upper 1/3 of the fish entirely enclosed by the hand.
2. Position the vent over the open egg sample container. Using the free hand, gently press out the eggs with the thumb and forefingers, applying pressure just forward of the genital pore (near vent).
3. Dispatch the fish with a clean knife or scalpel by severing the spinal cord just posterior to the brain.

4a. For darter/killifish, place the egg tissue in a sample container and transfer to wet ice.

4b. For mummichog specimens, count the eggs using a dissecting scope and/or weigh the egg mass with an electronic scale. If eggs are too numerous (e.g., hundreds of eggs) or not in a condition in which an accurate number of eggs can be estimated, a subset of eggs will be counted and weighed and recorded. The weight of the total egg mass will also be recorded, and the total number of eggs may be extrapolated based on the weight of the subset of eggs versus the weight of the total egg mass. Record these measurements for each individual mummichog specimen from which eggs are harvested.

5. Repeat the procedure with additional gravid female fish until sufficient egg mass/volume is obtained to meet project requirements.
6. Record the time and date on labels, close containers, and freeze samples for transport to laboratory for further processing.

B. Stomach Content Removal

After length and weight measurements have been recorded in the field laboratory notebook, the internal organs will be removed.

1. Wear appropriate PPE as required by the HSP. Outer gloves should be changed between each sample.
2. Rinse fish clean of sediment and organic material with distilled de-ionized water. Containerize rinsate and follow disposal procedures specified in Attachment K: Management and Disposal of Investigation-Derived Waste.
3. Carefully cut the fish open from the esophagus to the anus. Remove the internal organs and place them in a small clean aluminum pan.
4. The stomach will be carefully separated from the other organs in the aluminum pan and placed in an individual small clean aluminum pan. The fullness of the stomach will be recorded in the field laboratory notebook.
5. The stomach will then be cut open carefully, and a brief description of the contents will be recorded in the field laboratory notebook. The stomach contents will be scraped out, weighed (if possible), and placed in a tared glass jar. Stomach contents of different species will be separately jarred and evaluated.

The weight of the stomach contents (if measured) will be recorded in the field laboratory notebook.

6. The jar will be reweighed when all fish have been processed. The tare weight and the final weight of the jar will be recorded in the laboratory notebook.
7. The stomach contents sample will be preserved in 10% buffered formalin until shipped to the laboratory for identification to the lowest taxonomic level possible.

VIII. Laboratory Sample Processing

Fish and invertebrate samples are processed in the laboratory according to laboratory-specific methods based on the laboratory equipment, the analysis requirements, and specific guidance provided in the QAPP and Attachment O, Laboratory Processing of Fish and Decapod Tissue Composites and Homogenization (Windward 2009). In general, operations will follow the steps detailed below.

1. The homogenizing device will be cleaned as specified in the appropriate laboratory SOP (Attachment O), and the manufacturer's manual.
2. Tissues will be thawed at room temperature, if frozen.
3. Either: 1) whole organisms will be placed in the homogenizing device, or 2) samples will be resected as specified by the QAPP (Worksheet No. 11, Table 11-1), and resected portions (e.g., fillet and remaining carcass portions) designated for analysis will be placed in the homogenizing device.
    - Resecting may include removing the organism's skin, scales, shell, or exoskeleton.
4. Sample will be homogenized.
5. Sample will be extracted (if required) and analyzed.

IX. Sample Preservation

Generally, fish will be placed on wet ice on the boat, transferred to a freezer at the staging area (or processed if logistically acceptable), and shipped frozen to the analytical laboratory.

X. Quality Control Samples

To help identify potential sample contamination sources and to evaluate potential error introduced by sample collection and handling, field quality control (QC) samples will be collected during the fish tissue sample collection and processing. All QC samples will be labeled and sent to the laboratory with the other samples for analysis, if fish tissue samples are processed in the field. QC samples for fish tissue collection, wherever done, in the field or at the laboratory, will include rinsate of homogenization equipment samples, field duplicate samples, and matrix spike/matrix spike duplicate samples, and will be collected at the frequency specified in the QAPP.

XI. Reference

Integral, Windward, Ellis Ecological Services. 2005. Portland Harbor RI/FS Appendix A: Standard operating procedures for fish dissection, tissue sample handling and processing. Prepared for Lower Willamette Group. Integral Consulting, Inc., Mercer

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Tierra Solutions. 1999. Passaic River Study Area ecological sampling plan. Work plan/field sampling plan. Volume 1 of 6. Tierra Solutions, Inc., Newark, NJ.

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Attachment L: SOP—Fish Collection by Backpack and Boat Electrofishing (Revision 1 dated June 21, 2010)

I. Purpose

The purpose of this procedure is to provide reference information for the collection of fish using electrofishing equipment for the Lower Passaic River Restoration Project. Electrofishing is a fishing technique that employs electrical power to temporarily stun fish within an effective range. Ambient conductivity and the size and species of fish help determine the appropriate voltage to be selected for stunning the fish and increase the success of returning fish unharmed to the water. This sampling technique can be used in combination with other active or inactive sampling methods to determine the representation of the fish community in an aquatic environment.

II. Preparations for Sampling

The quality assurance project plan (QAPP) (Windward 2009). identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the FSP prior to conducting field activities and ensuring that all field equipment is available and in acceptable condition.

III. Definitions

A. Backpack electrofishing

Backpack electrofishing equipment is designed to sample wadeable streams and shallow waters effectively. Backpack electrofishing can only be done in the shallow hard-bottom areas within 1 mile of Dundee Dam. Backpack electrofishing equipment consists of a power source and a variable voltage pulsator (VVP) on a backpack frame with an anode and cathode (positive and negative electrodes, respectively) attached to the VVP. The backpack typically weighs between 30 and 50 pounds. Common power sources include a 12-volt battery or a small gas-powered generator. The VVP controls the output voltage, amperage, the pulse interval and the pulse duration. The VVP produces half waves so the fish are not exposed to a constant voltage. The voltage required is dependent upon the conductivity of the water. Waters with high conductivity or low resistance (expressed in ohms) require less voltage than waters with low conductivity. A meter on the VVP is used to monitor the current between the electrodes and typically expresses this current in terms of amps or watts. Two types of currents can be used: direct current (DC) and alternating current (AC). Direct current uses one negative electrode and at least one positive electrode to generate an electric field. Fish within the electrical field respond to the current by involuntarily swimming (termed galvanotaxis) towards the anode. However, before reaching the positive electrode, fish become narcotized and stupefied. Fish within the electrical field of alternating currents do not swim toward the anode but instead remain in a position between the two electrodes. Direct current is thought to be safer and less harmful to fish (Lyons 1992). Body color can also be affected by electrofishing due to pigment contractions. With time, fish will recover from the shock and are able to swim away (Ellis 2007).

B. Boat electrofishing

Boat electrofishing equipment is similar to backpack electrofishing equipment, but it is designed to sample deeper waters that require more powerful equipment. It is an active method conducted along a bank of a river or shoreline of a lake to collect fish. In addition, this method is the most efficient and effective for surveying a variety of fish species because it is not selective and can easily be applied in areas that have obstructions or uneven river bottoms. However, it is ineffective and not commonly used for fish sampling in salt-water environments. To adequately power the boat electrofishing equipment, a gas generator that produces 2,000 watts or more should be used. The boat is the staging area for the electrofishing equipment, and the sampling locations are sampled from the boat. There are different configurations for setting up the electrical equipment, and the user's manual will help determine the best one to use. In addition, the sampling location, water depth, conductivity, and fish species will be evaluated to determine an appropriate setup on the boat. Normally, the VVP is positioned near or in the console of the boat. The electrical current from the water to the VVP travels through the flexible metal conduit. Often the front probes or wands are constructed of fiberglass with flexible metal conduit attached to their anterior ends (Ellis 2007). The boat operator is able to carefully position the boat and the wands to access areas with obstructions (e.g., large woody debris, beds of aquatic plants) because of the flexible nature of the metal conduit.

IV. Equipment and supplies

A. Backpack electrofishing

- Backpack electrofishing unit, including power source, VVP, anode and cathode
- Spare anode
- Large, long fiberglass handled dip nets
- Fish collection bucket
- Chest waders and electrical safety gloves
- Conductivity meter
- Fish scale and measuring board
- Polarized sunglasses

B. Boat electrofishing

- Boat with or without metal hull
- Portable electrofishing unit, including power source, an electronic pulsator, an anode, a cathode, cable and switches
- Large, long fiberglass-handled dip nets
- Fish collection bucket
- Chest waders and electrical safety gloves
- Conductivity meter
- Fish scale and measuring board
- Polarized sunglasses

C. Safety supplies
   - Electrical safety gloves
   - Fire extinguisher
   - Personal flotation device(s)

V. Field Procedure

A. The following procedures will be applied for electrofishing using either a backpack or boat unit:
   1. All electrofishing activities will be conducted during the day, which allows for safety and better visibility of fish behavior and river conditions. Substrate conditions (e.g., soft or unstable) may limit when backpack electrofishing can be safely used. If shoreline conditions appear unsafe or unsuitable, electrofishing activities will be abandoned at those sites.
   2. If the size of the fish is less than 25 mm in length, the fish will not be collected or processed because electrofishing is an ineffective fishing technique for properly sampling smaller fish. In addition, smaller fish are difficult to identify.
   3. No electrofishing will occur when water temperatures are above 18° C or are expected to increase above this temperature prior to concluding electrofishing activities if salmonids are present. If salmonids are not present, electrofishing may be conducted because any potential damage to fish would not impact the chemical analysis of the tissue.
   4. Any change in VVP settings will be recorded in the field notebook.
   5. Fish are expected to recover within 5 seconds of being shocked depending on the fish species. If fish do not recover as quickly as expected, the VVP settings should be reduced until fish recovery time is reduced (Smith-Root 2007c).
   6. All instances of stunned fish will be recorded in the field notebook, including date and time of encounter. The length of time spent at one particular location will also be recorded.
   7. The electrofishing unit's user's manual will be consulted to ensure proper operation techniques are employed.
   8. After fish are sorted, identified, and measured, all fish species will be returned to the water, with the exception any sacrificed fish specimen that will be retained for tissue analysis, health assessments, egg tissue collection, or stomach content collection.

B. Backpack electrofishing
   1. Backpack electrofishing requires two certified field technicians. One technician will wear and operate the backpack electroshocker while the second technician collects stunned fish in a net. The technician operating the electroshocker will hold the anode wand in one hand and drag the cathode in the water. The first technician will also be responsible for adjusting VVP settings.
   2. The technician with the electroshocker will slowly pass the anode over desired areas, creating an electric field. At no time should either technician reach into the water while the electroshocker is turned on.

3. The second technician will follow with a fish net and collection bucket to collect the stunned fish. This technician will determine whether the settings are appropriate based upon the observed fish response.
4. Direct current will be used whenever possible but waters with a low conductivity may require an alternating current (Lyons 1992). Initial pulse frequency, duration, and voltage should be on low settings and increased as needed based upon observed fish response. A lower frequency is typically used for larger fish (Smith-Root 2007c).
5. Voltage for the backpack electrofishing unit will be determined based upon the conductivity of the water and fish behavior. A conductivity meter will be used to determine the following voltage settings:

Conductivity (mS/cm)	Voltage
Less than 100	900 to 1,100
100 to 300	500 to 800
Greater than 300	to 400

Source: Regional Road Maintenance Endangered Species Act Program Guidelines, Appendix E (WSDOT 2003)

C. Boat electrofishing

1. Boat electrofishing requires two certified field technicians working from the boat and a boat operator. All personnel will be aware of the kill switches for the electrofishing equipment and power sources. The boat operator will deliver the shock with an output current and pulse rate that will be determined by the water conductivity, fish species, and fish behavior. Generally, two 28 cm anodes and a voltage of 240 volts provide good fishing effectiveness in 0.4 mS/cm conductivity with a current of 3 to 4 amperes. In lower conductivities of 0.04 mS/cm, a current of 1 to 1.5 amperes is effective (Smith-Root 2007a). The user's manual will be reviewed and referenced for selecting the appropriate settings for electrofishing.
2. Both field technicians will wear chest waders and electrical safety gloves aboard the boat while they wait for the stunned fish to rise to the surface of the water. The technicians will be on positioned on opposite sides of the boat and will use long dip nets at the bow of the boat to collect the fish. A safety rail will border the bow of the boat to keep the technicians from falling into the water during the electrofishing activities and fish collection.
3. All fish species stunned will be immediately collected and placed in a collection bucket with site water and air pumps. One technician will sort, identify, weigh, and measure a subset of each fish species, while the other technician will record the information on the field sampling form. The technicians netting the fish will also stay inside the radius of the anode pole to remain clear of the voltage source.
4. Waters with a depth greater than 10 ft cannot be sampled effectively. In addition, flows greater than 5 ft per second produce poor electrofishing efficiencies.

VI. Maintenance

Maintenance procedures are based upon information from the following manuals:

- *Smith-Root User's Manual for the LR-20 and LR-24 Electrofisher* (Smith-Root 2007b, c)
- *Smith-Root User's Manual for the GPP 2.5,5.0,7.5 and 9.0 Portable Electrofisher* (Smith-Root 2007a)

A. Backpack electrofishing

1. Batteries should be recharged as soon as possible after electrofishing is complete, regardless of the level of discharge. The battery will be plugged into a charging device according to manual instructions and allowed to completely recharge before use. The battery should not be allowed to completely discharge during use. If a battery is maintained properly, it should last from 3 to 5 years. If a battery is to be stored for an extended period of time, it should be completely recharged prior to storage and recharged every 3 to 4 months at 20°C. The battery may require additional charging if stored at higher temperatures, but storage above 20°C and below -30°C should be avoided. Batteries can also be stored on a maintenance charger to avoid periodic recharging. The recommended operation temperature is between 5°C and 35°C. Batteries are to be cleaned with soap and water and stored in foam packaging away from oils and solvents. All cords should be coiled for storage (Smith-Root 2007c).
2. Maintenance cleaning should be done with warm water and mild soap only. Equipment should be rinsed before being cleaned to remove any material that may scratch the display window. Anodes should be kept clean to avoid an oxide coating. Oxide coatings can be removed with fine steel wool (Smith-Root 2007b, c).
3. Electrodes can be tested according the user's manual instructions if a problem arises. If the anode pole does not pass the test, the pole should be replaced. If the pole passes the test and the problem remains, the electrofishing unit should be returned for repair. If a cathode test fails, the cable should be replaced (Smith-Root 2007c).

B. Boat electrofishing

1. Store the electrofishing unit in a dry area free from extreme temperatures.
2. Clean the front panel of the unit with a mild spray-on cleaner.
3. During transportation, keep the unit well secured and protected from coming into contact with other objects and from continuous vibration.
4. Regularly check the connectors, wires, and equipment for damage or corrosion.
5. Perform general maintenance of the generator, such as changing oil engine, spark plugs, fuel, etc.

VII. Calibration

Calibration is conducted and maintained by the manufacturer for both the backpack electrofishing and the boat electrofishing units.

VIII. Quality Control

During all electrofishing activities, fish behavior and response to the electrical settings will be monitored and the settings adjusted to minimize harm to the fish. All the equipment and supplies will be regularly inspected for dirt, corrosion, or damage that may prevent them from operating properly. The equipment and supplies will be cleaned and repaired to ensure they work correctly. In addition, the user's manuals will be reviewed for information on how to properly operate all the equipment and supplies.

IX. References

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Lyons J. 1992. Using the index of biotic integrity (IBI) to measure environmental quality in warmwater streams of Wisconsin. General technical report NC-149. North Central Forest Experiment Station, Forest Service, US Department of Agriculture, St. Paul, MN.

Smith-Root. 2007a. User's manual, GPP 2.5, 5.0, 7.5 and 9.0 portable electrofishers (Honda/Vanguard generators). Smith-Root, Inc., Vancouver, WA.

Smith-Root. 2007b. User's manual, LR-20 backpack electrofisher. Smith-Root, Inc., Vancouver, WA.

Smith-Root. 2007c. User's manual, LR-24 electrofisher. Smith-Root, Inc., Vancouver, WA.

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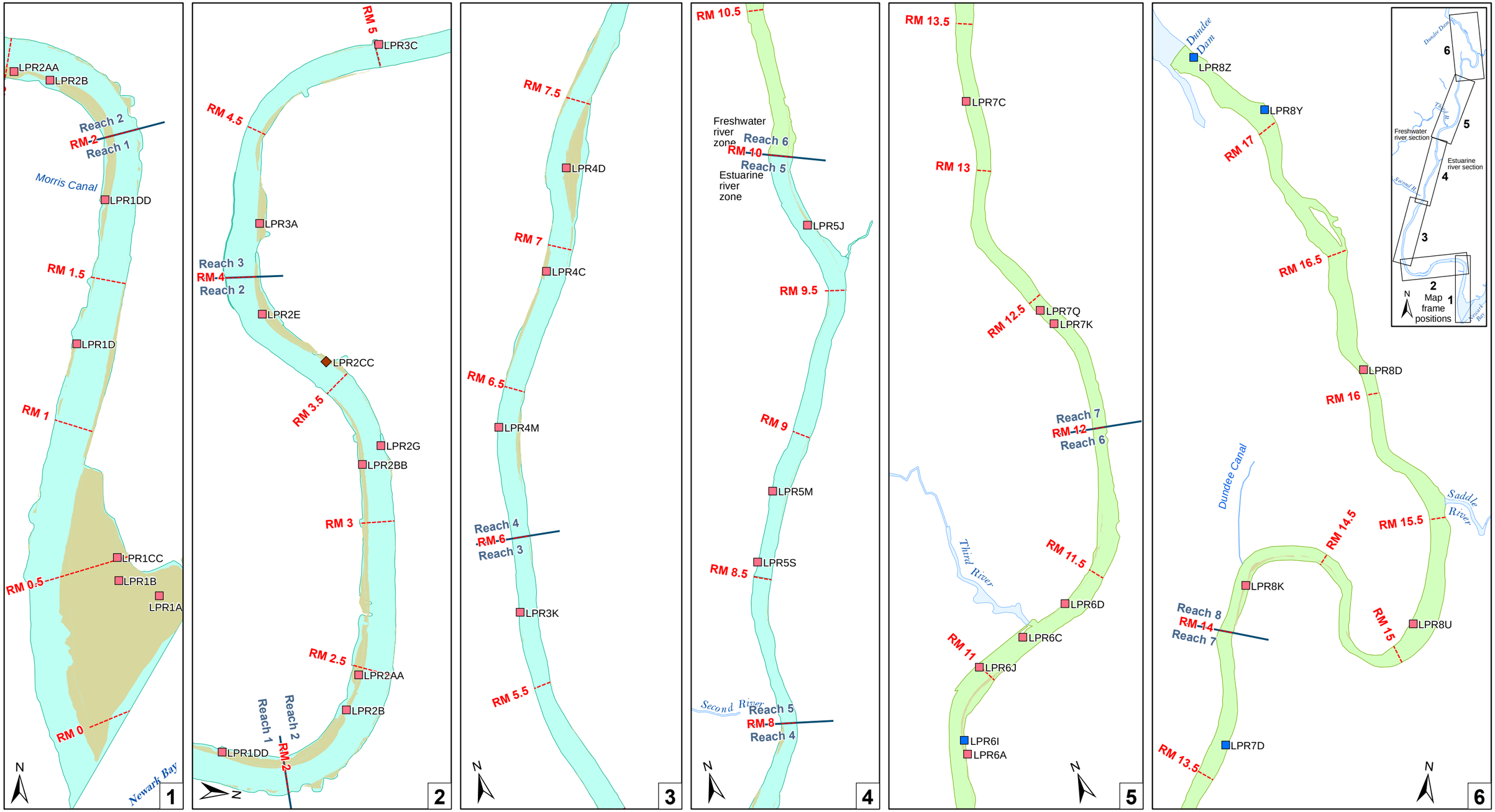
Oversize Figure



Wind Ward environmental LLC

0 0.5 1 Kilometers

0 0.25 0.5 Miles

Proposed sample location
- Minnow trap
- Backpack electrofishing
- Alternative location identified by USEPA/PA
- Sampling reach boundary
- River mile
- Mudflat

LPRSA
- Estuarine river section
- Freshwater river section
- Upper Passaic River or tributary

Mudflat locations are determined as those areas of fine (i.e., silt or sand) sediment substrate, where the river bottom slope is ≤6° and the depth is ≥-4.5 ft NGVD29 (i.e. -2 ft MLLW). LPRSA sediment grain size is based on map layers from the Draft Technical Report, geophysical Survey (Aqua Survey, Inc., 2005a). LPRSA bathymetry is taken from the 2007 bathymetric survey conducted by Gahagan & Bryant Associates, Inc. (GBA), except for the area outside Kearny Point; bathymetry in the southeast part of this area is estimated based on NOAA data. In the GBA survey area, multibeam data are used where available and single-beam data are used where they are not.

Figure 1. Proposed sampling locations for the LPRSA late spring/early summer 2010 small forage fish tissue collection effort

Created by LSM 3/11/10, map 4122; W:\Projects\06-58-01 Passaic RI\Data\GIS\Analysis_and_Maps\Fish2010